

Report for 2002WI3B: Field Evaluation of Raingardens as a Method for Enhancing Groundwater Recharge

There are no reported publications resulting from this project.

Report Follows:

Field evaluation of raingardens as a method for enhancing groundwater recharge

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In urbanized areas of Wisconsin that rely on groundwater as the primary source of water, groundwater withdrawals significantly exceed groundwater recharge rates. This can lead to environmental degradation, as it reduces the discharge of groundwater to springs, wetlands, streams, and lakes and their associated ecosystems. Raingardens, sunken gardens that receive stormwater runoff, appear to offer a solution to groundwater loss. In an ongoing research project, the PI has used a numerical model to demonstrate that a raingarden with area equal to 10% of the connected pervious area can double the local groundwater recharge rate. The explanation of this surprising result is that focusing of runoff to a small, highly pervious area greatly reduces losses to evapotranspiration.

Before raingardens are widely implemented, they should be tested through carefully designed demonstration projects. The goals of this project are to construct an experimental raingarden and use it to improve our understanding of, and ability to model, raingarden performance. At our experimental raingarden we will monitor precipitation, inflows, soil moisture, outflows, and seepage from the root zone. We will also numerically simulate the performance of the raingarden using a previously developed model. Comparisons of the modeling and experimental results will enable us to verify the accuracy of the former, and correct if necessary.

Project Update

We have constructed an experimental raingarden, at the Dane County Parks Lussier Family Heritage Center in Madison. The raingarden is lined so that the drainage can be collected and measured. The raingarden has an area of 5.4 m² and is connected to two downspouts, each draining about 55 m² of roof. Valves allow one or both roof areas to be connected, yielding area ratios of 0.05 and 0.10. Roof runoff is measured by means of a prerated trapezoidal flume in which a pressure transducer has been installed. Another transducer monitors the ponded depth in the raingarden. Runoff from overspill is collected in an overflow tank. To estimate soil moisture storage, Time Domain Reflectometry (TDR) probes were placed at seven depths and connected to a multiplexer, cable tester, and data logger. Seepage through the raingarden (which we take to be recharge) flows through a bottom drain to a pipe that discharges into a seepage collection tank. The tank contains a siphon that empties and triggers a switch when it accumulates 112 liters. The tank also contains a pressure transducer for monitoring changing water levels.

Full instrumentation of the experimental raingarden was achieved in the summer of 2002. Three controlled experiments were run to provide validation data for the Richards Equation model. For these experiments, a water source was used to provide a constant application rate until the raingarden ponded to 15 cm. The soil moisture data obtained from these experiments compared reasonably well with the model predictions. However, the measured drainage volumes were 13 to 27% lower than the predicted volumes. We concluded that the discrepancy was due to leakage through the openings that provide access to the TDR probes, and have taken steps to greatly reduce the leakage rates. In the spring of 2003 we took steps to eliminate the leakage.

Funding has been obtained to continue operation of the raingarden for an additional two years. This will enable long-term observations of raingarden performance, including observations during snowmelt periods.